Project Title: Design and Performance of Lightly Trafficked Roads

Background:

Most models of vehicle-induced pavement damage in the civil engineering literature represent vehicles as static contact loads. Such studies ignore the effects of surface roughness and pavement strength variations on the dynamic tyre loads generated by heavy vehicles and on the damage feedback mechanisms that affect long-term pavement responses.

The majority of pavement material models assume linear viscoelastic asphalt layers with linear elastic sub-pavement layers. Recent work by Hadi and Bodhinayake (Hadi, 2003) has shown that these traditional assumptions may be inadequate. In addition, finite element analysis is often time consuming and is consequently unsuited for pavement design purposes.

The ideal solution is for road researchers and road management authorities to have a user-friendly software tool that is flexible enough to represent their particular environmental conditions, heavy goods traffic, and pavement geometry conditions; while producing an accurate estimate of life and serviceability. In order to accomplish this goal, the software must use state of the art material degradation models and vehicle-road interaction models and be accessible to the non-specialist user.

Approach:

The development of a flexible software system for modelling whole-life pavement response to dynamic vehicle loads and environmental conditions is the primary objective of this project. The modelling will build upon previous work by Collop & Cebon (1995, 1997) and Costanzi & Cebon (2007). It is intended that the resulting software will have value as a research tool and also for applied pavement response modelling and pavement design exercises.

The first part of the model development will be to use the ABAQUS Finite Element program, with a user material (UMAT) constitutive model, developed at the University of Cambridge, to model the permanent deformation behaviour of asphalts to heavy vehicle loading (Ossa, 2005). Initial model validation will be undertaken using material performance data and wheel-tracking tests provided by the University of Nottingham.

Next, a software framework will be developed that combines pavement response and damage models with dynamic heavy vehicle simulations. This framework will be the nucleus of a user-friendly software package that will be created as a physical deliverable from this project for use by researchers and pavement practitioners.

Parametric studies will be performed with the system to investigate the effects of various factors on long-term high strength pavement performance. These will include the effects of: dynamic loading, suspension performance, initial surface roughness, structural variations and maintenance intervention policies.

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References:

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